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340/450.3; 73/40, 49.2, 114.56, 114.57

- See application file for complete search history.

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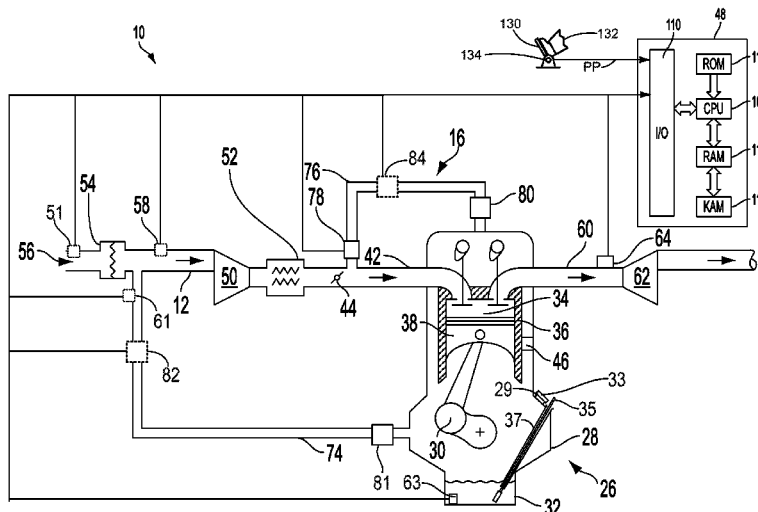
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- (57) **ABSTRACT**

- Embodiments for detecting crankcase breach are provided. In one example, a method includes indicating both crankcase ventilation system degradation and a crankcase oil sump level based on a common crankcase sensor. In this way, the same sensor can provide both crankcase breach detection and oil level determination.

- 12 Claims, 4 Drawing Sheets**



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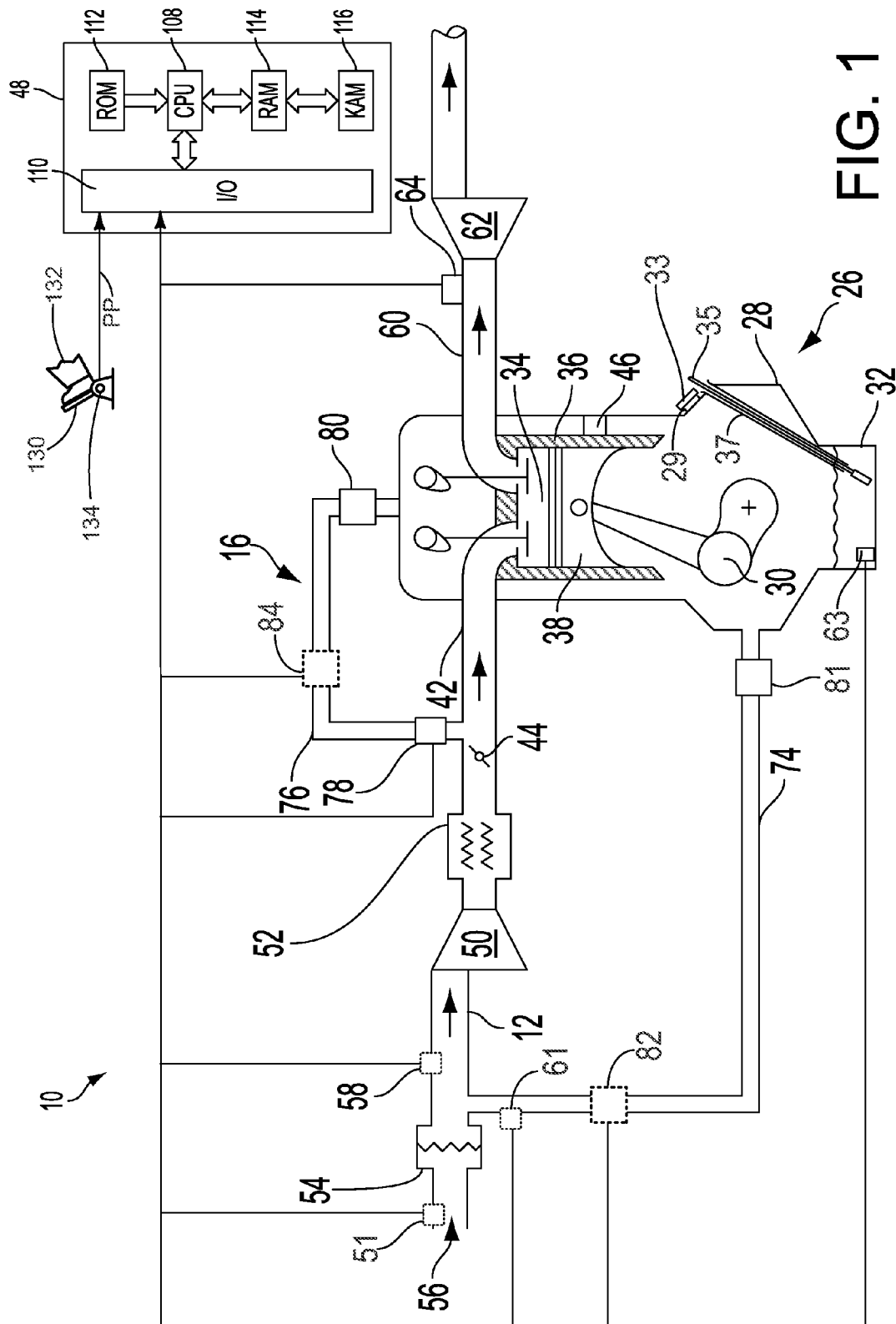
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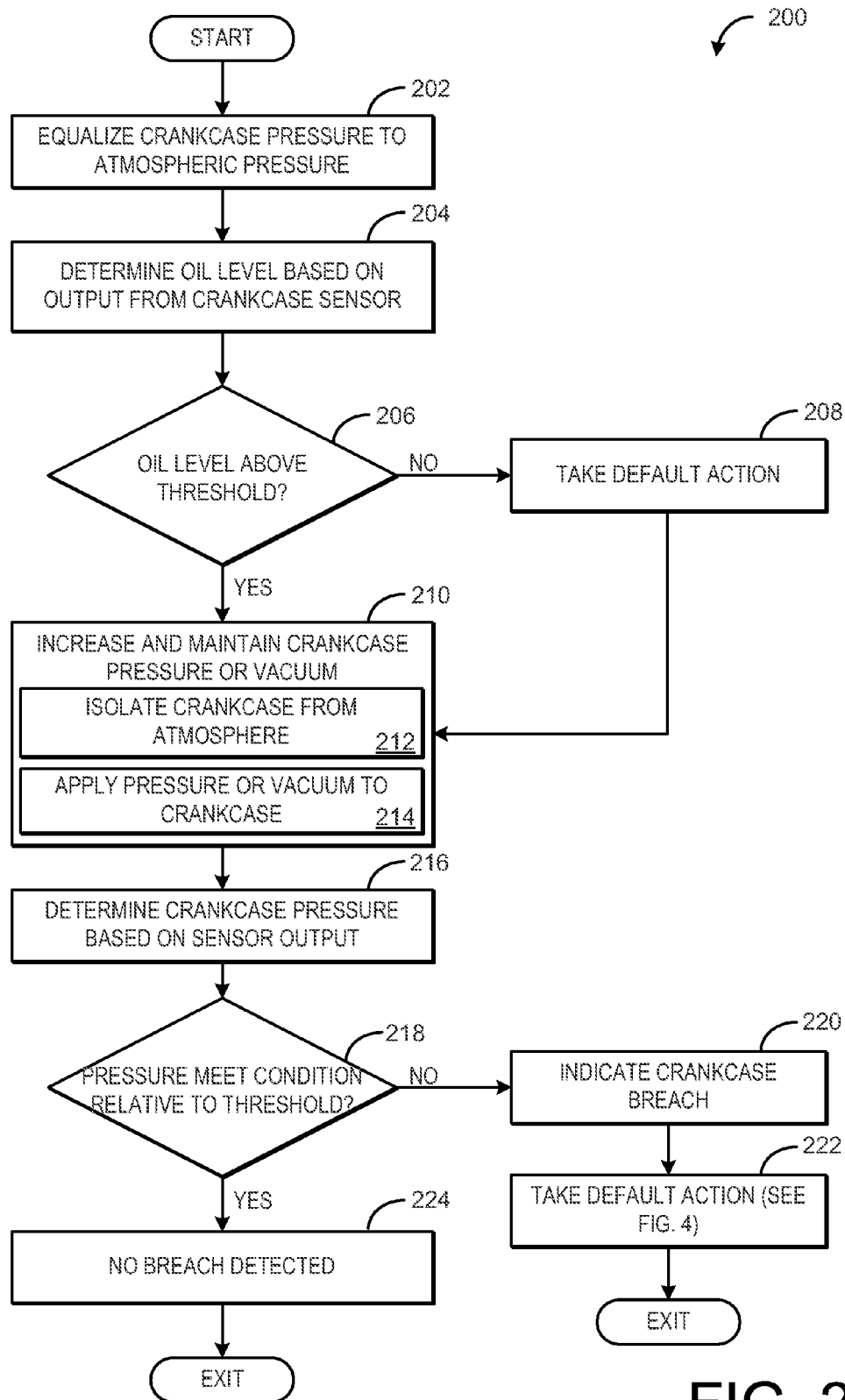


FIG. 2

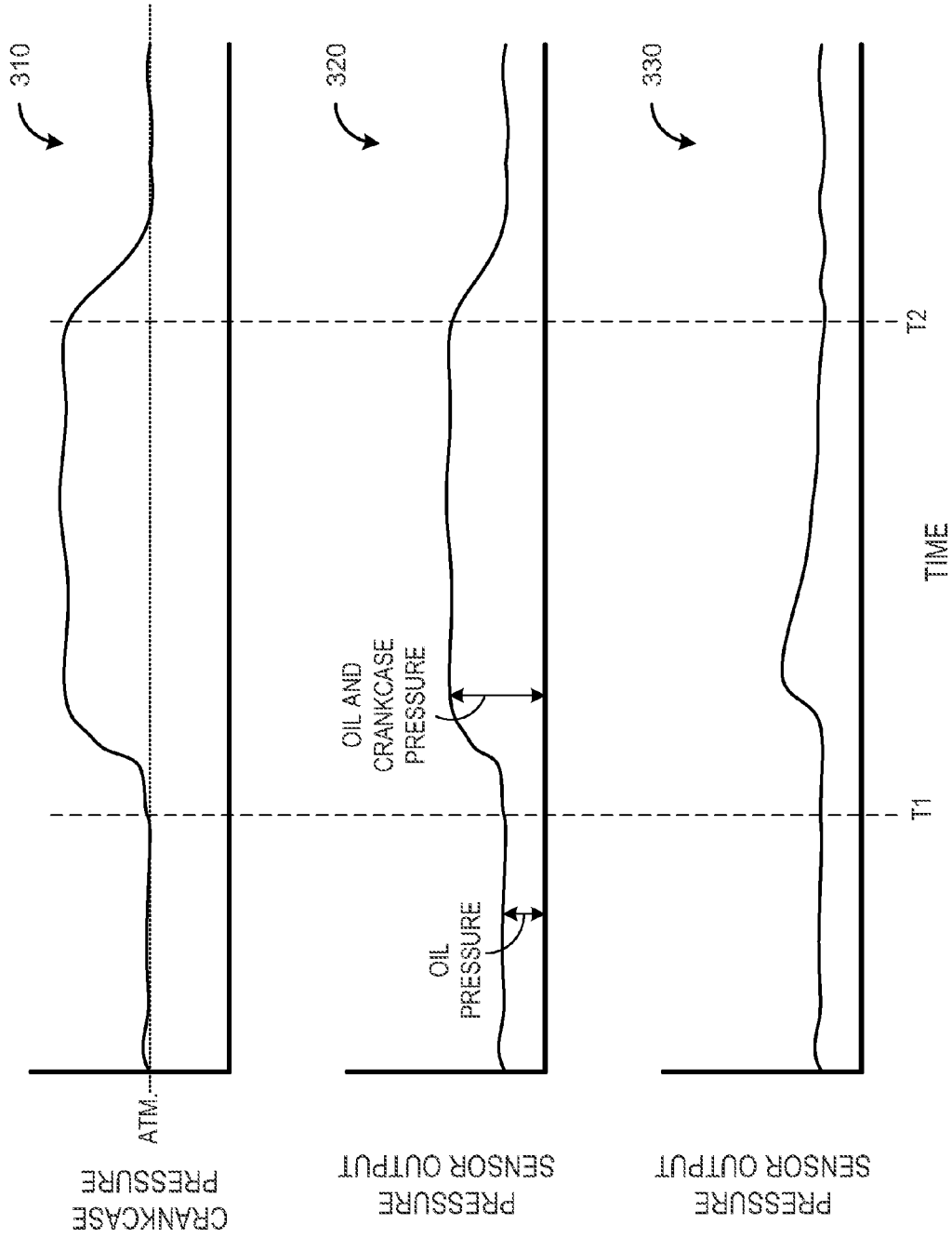


FIG. 3

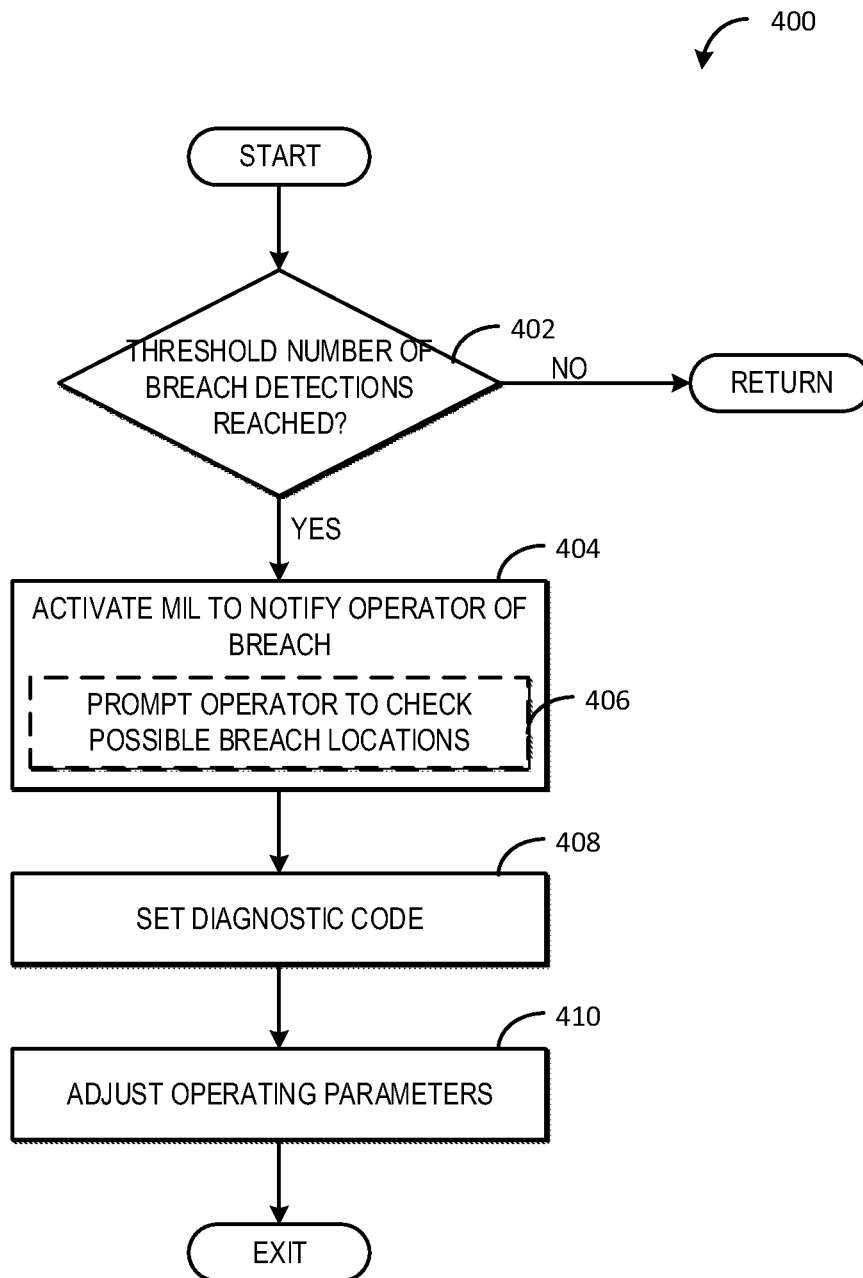


FIG. 4

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METHOD FOR DETERMINING CRANKCASE BREACH AND OIL LEVEL

FIELD

The present disclosure relates to crankcase breach detection.

BACKGROUND AND SUMMARY

Engines may include crankcase ventilation systems to vent gases out of the crankcase and into an engine intake manifold to provide evacuation of gases from inside the crankcase in order to reduce degradation of various engine components in the crankcase.

Under certain conditions, crankcase ventilation systems may be monitored to identify breaches in the system. For example, a fresh air hose (breather tube) may become disconnected, an oil cap may be off or loose, a dipstick may be out of position, and/or other seals in the crankcase ventilation system may be broken. Following a crankcase breach, degradation of various components included in the crankcase may occur, or the gases may not be properly ingested into the engine to be rendered innocuous.

Various approaches may be used to monitor crankcase ventilation system integrity. For example, a pressure sensor may be used in the crankcase and a valve in a crankcase vent tube may be opened so that pressure or vacuum changes may be sensed in the crankcase to determine if there is a breach in the system.

In other approaches, a plurality of absolute sensors, e.g., a barometric pressure sensor (BP), a compressor inlet pressure sensor (CIP), a throttle inlet pressure sensor (TIP), a manifold air pressure sensor (MAP), and/or a pressure sensor in a crankcase vent hose, etc., may be used in combination to monitor crankcase ventilation system integrity.

However, the inventors herein have recognized that such approaches may add additional hardware to such monitoring systems, e.g., additional sensors and valves, thus increasing costs and complexity of a crankcase ventilation monitoring system. Additionally, some of these sensors may be underutilized, e.g., the crankcase pressure sensor may only be used for crankcase breach detection, thus limiting the value of such sensors.

Thus, in one approach, to at least partially address these issues, an engine method is provided. The method comprises indicating both crankcase ventilation system degradation and a crankcase oil sump level based on a common crankcase sensor.

In this way, the same sensor information may be used for both crankcase breach detection and oil level determination. For example, a crankcase pressure sensor may be positioned in the crankcase oil sump such that it is immersed in oil during engine operation. Under certain conditions, such as when the crankcase is exposed to atmospheric pressure, the pressure sensor may output pressure correlated primarily (or sometimes only) to the oil in the oil sump, which may be converted to the oil level. Then, under other conditions, such as when the crankcase is sealed (e.g., one or more valves coupling the crankcase to atmosphere are closed) and pressure or vacuum is applied to the crankcase, the pressure sensor may output the sum of the oil sump pressure (pressure due the depth below the liquid surface) and the gas pressure of the crankcase. The gas pressure of the crankcase may then be used to determine if a crankcase breach is present and various actions taken in response thereto.

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Thus, in one example, a common crankcase sensor may be used both for detecting crankcase breach and for sensing oil level. In doing so, engine hardware may be reduced, lowering cost and reducing system complexity. Further, by immersing the pressure sensor in engine oil, mechanical damping may be provided by the oil, reducing noise in the pressure signal and improving accuracy of the pressure detection.

The above advantages and other advantages, and features of the present description will be readily apparent from the following Detailed Description when taken alone or in connection with the accompanying drawings.

It should be understood that the summary above is provided to introduce in simplified form a selection of concepts that are further described in the detailed description. It is not meant to identify key or essential features of the claimed subject matter, the scope of which is defined uniquely by the claims that follow the detailed description. Furthermore, the claimed subject matter is not limited to implementations that solve any disadvantages noted above or in any part of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a partial engine view according to an embodiment of the present disclosure.

FIG. 2 shows an example method for determining oil level and crankcase pressure according to an embodiment of the present disclosure.

FIG. 3 shows example pressure sensor output with and without crankcase breach.

FIG. 4 shows an example method for notifying an operator of crankcase breach according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

In order to detect and respond to crankcase breach, where crankcase gas vapors may escape to the atmosphere via an uncapped lubricant filling port or unsealed dipstick, for example, engine crankcases may include a sensor, such as a pressure sensor. Under certain operating conditions when the crankcase is isolated from the atmosphere and pressure or vacuum is applied to the crankcase, the sensor may be used to detect breach. In addition, if the crankcase sensor is immersed in the oil in the oil sump, when the crankcase pressure is equalized with atmospheric pressure or another reference pressure, the crankcase sensor may be also be used as an oil level sensor. Thus, a single sensor may be utilized to both detect breach and determine oil level. FIG. 1 is a diagram of engine including a crankcase sensor immersed in engine oil. The engine of FIG. 1 also includes a controller which may carry out one or more control routines, such as the methods of FIG. 2 and FIG. 4. Example pressure sensor outputs during the breach detection are depicted in FIG. 3.

Referring now to FIG. 1, it shows an example system configuration of a multi-cylinder engine, generally depicted at 10, which may be included in a propulsion system of an automobile. Engine 10 may be controlled at least partially by a control system including controller 48 and by input from a vehicle operator 132 via an input device 130. In this example, input device 130 includes an accelerator pedal and a pedal position sensor 134 for generating a proportional pedal position signal PP.

Engine 10 may include a lower portion of the engine block, indicated generally at 26, which may include a crankcase 28 encasing a crankshaft 30. Crankcase 28 contains gas and includes an oil sump 32, otherwise referred to as an oil well,

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holding engine lubricant (e.g., oil) positioned below the crankshaft. An oil fill port **29** may be disposed in crankcase **28** so that oil may be supplied to oil sump **32**. Oil fill port **29** may include an oil cap **33** to seal oil port **29** when the engine is in operation. A dip stick tube **37** may also be disposed in crankcase **28** and may include a dipstick **35** for measuring a level of oil in oil sump **32**. In addition, crankcase **28** may include a plurality of other orifices for servicing components in crankcase **28**. These orifices in crankcase **28** may be maintained closed during engine operation so that a crankcase ventilation system (described below) may operate during engine operation.

The upper portion of engine block **26** may include a combustion chamber (i.e., cylinder) **34**. The combustion chamber **34** may include combustion chamber walls **36** with piston **38** positioned therein. Piston **38** may be coupled to crankshaft **30** so that reciprocating motion of the piston is translated into rotational motion of the crankshaft. Combustion chamber **34** may receive fuel from fuel injectors (not shown) and intake air from intake manifold **42** which is positioned downstream of throttle **44**. The engine block **26** may also include an engine coolant temperature (ECT) sensor **46** input into an engine controller **48** (described in more detail below herein).

A throttle **44** may be disposed in the engine intake to control the airflow entering intake manifold **42** and may be preceded upstream by compressor **50** followed by charge air cooler **52**, for example. An air filter **54** may be positioned upstream compressor **50** and may filter fresh air entering intake passage **56**.

Exhaust combustion gases exit the combustion chamber **34** via exhaust passage **60** located upstream of turbine **62**. An exhaust gas sensor **64** may be disposed along exhaust passage **60** upstream of turbine **62**. Turbine **62** may be equipped with a wastegate bypassing it. Sensor **64** may be a suitable sensor for providing an indication of exhaust gas air/fuel ratio such as a linear oxygen sensor or UEGO (universal or wide-range exhaust gas oxygen), a two-state oxygen sensor or EGO, a HEGO (heated EGO), a NO_x, HC, or CO sensor. Exhaust gas sensor **64** may be connected with controller **48**.

In the example of FIG. 1 a positive crankcase ventilation system (PCV) **16** is coupled to the engine intake so that gases in the crankcase may be vented in a controlled manner from the crankcase. The crankcase ventilation system **16** draws air into crankcase **28** via a breather or vent tube **74**. Breather tube **74** may be coupled to fresh air intake **12** upstream of compressor **50**. In some examples, breather tube may be coupled to intake **12** downstream of air filter **54**. In other examples, breather tube may be coupled to air filter **54**.

In the case where MAP (pressure at intake manifold **42**) is lower than CIP (pressure at fresh air intake **12**), the crankcase ventilation system vents air out of the crankcase and into intake manifold **42** via conduit **76** which, in some examples, may include a one-way PCV valve **78** to provide continual evacuation of gases from inside the crankcase **28** before connecting to the intake manifold **42**. In the case where the pressure at crankcase **28** (crankcase pressure) is greater than the pressure sensed by pressure sensor **61**, gases flow from the crankcase, through oil separator **81** and into fresh air intake **12** and eventually into the combustion chamber **34**. This may be done in a stale air manner where no intake manifold air is let into the crankcase or in a positive crankcase ventilation manner where some manifold air is metered into the crankcase. However, in other examples conduit **76** may not include a one-way PCV valve.

Other systems may be designed for uni-directional operation where the crankcase gases only leave via a single path, out the vent tube **74** into the engine air inlet. These systems

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yield the benefit of having only one oil separator. As shown in the example of FIG. 1, the PCV conduit **76** may include a uni-directional oil separator **80** which filters oil from vapors exiting crankcase **28** before they re-enter the intake system **12**. Another oil separator **81** may be disposed in breather tube **74** to filter oil from vapors exiting crankcase **28**. In some examples, PCV conduit **76** may also include a vacuum sensor coupled to the PCV system. In some examples, gas flow in breather tube **74** may go in both directions, from crankcase **28** towards intake **12** and/or from intake **12** towards crankcase **28**. Further, in some examples, during certain engine operating conditions, e.g., in turbocharger applications, gas may flow through conduit **76** in both directions, from crankcase **28** towards intake manifold **42** and/or from intake manifold **42** towards crankcase **28**.

While the engine is running under light load and moderate throttle opening, the intake manifold air pressure may be less than crankcase air pressure. The lower pressure of the intake manifold draws fresh air towards it, pulling air from the crankcase vent tube **74** through the crankcase (where it dilutes and mixes with combustion gases), out of the crankcase via the PCV conduit through the PCV valve, and into the intake manifold. However, during other conditions, such as heavy load or under boosted conditions, the intake manifold air pressure may be greater than crankcase air pressure. As such, intake air may travel through the PCV conduit and into the crankcase.

Controller **48** is shown in FIG. 1 as a microcomputer, including microprocessor unit **108**, input/output ports **110**, an electronic storage medium for executable programs and calibration values shown as read only memory chip **112** in this particular example, random access memory **114**, keep alive memory **116**, and a data bus. Controller **48** may receive various signals from various sensors coupled to engine **10**, engine coolant temperature (ECT) from temperature sensor **46**; exhaust gas air/fuel ratio from exhaust gas sensor **64**; and other PCV diagnostic sensors described below. Storage medium read-only memory **112** can be programmed with computer readable data representing instructions executable by processor **108** for performing the methods described below, as well as other variants that are anticipated but not specifically listed.

As remarked above, under certain conditions, crankcase ventilation systems may be monitored via a variety of sensors to identify breaches in the crankcase ventilation system. For example, a crankcase vent tube may become disconnected, an oil cap may be off or loose, a dipstick may be out, and/or other seals in the crankcase ventilation system may be compromised. Degradation of various components included in the crankcase may then occur.

Diagnostic blow by approaches may be used to monitor crankcase ventilation system integrity. For example, a valve **82** in the crankcase vent tube **74** may be opened so that pressure or vacuum changes may be sensed in the crankcase to determine if there is a breach in the ventilation system. Another approach may close the valve **82** in the breather tube **74** as well as isolation valves in PCV conduit **76** in order to isolate the crankcase from the atmosphere. For example, manually controlled versions of these isolation valves appear in the 1952 WILLYS® military vehicle with the designation "M38". One operator fording control resulted in closing both valves which resulted in crankcase pressurization, useful for preventing water ingress. During engine operation, as the engine heats up, or due to blow-by gases entering the crankcase, the pressure in the crankcase may increase. Valves **82** and **84** may be electronically actuated valves that are typically

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kept open to permit normal PCV operation, but commanded closed by the controller in order to detect breach.

Electronic control of these valves offer the opportunity to pressurize the crankcase by closing both valves and limiting the degree of pressurization by monitoring crankcase pressure during this configuration. Closing the vent valve **82** and opening valve **84** imposes a vacuum on the crankcase. In this way, via pressurization or imposing a vacuum in the crankcase, crankcase integrity can be assessed.

The pressure changes in the crankcase may be sensed by sensor **63**. As depicted in FIG. **1**, sensor **63** is immersed in the oil contained in the oil sump **32**. Sensor **63** may be a pressure sensor which may be dually utilized to sense crankcase pressure under some conditions and the oil level of the oil sump **32** under other conditions. Alternatively or additionally, sensor **63** may be an oil level sensor (e.g., a float) which, when exposed to a reference pressure, may be used to determine crankcase pressure. Additional details regarding detecting crankcase pressure and oil level using a single sensor in the oil well will be provided below with regard to FIGS. **2** and **3**.

Alternatively, an embodiment with no isolation valves may generate a vacuum in the crankcase due to the evacuation provided by the vacuum that forms in tube **74** during high engine air flow rates. In this embodiment, a sensed vacuum in the crankcase confirms crankcase integrity and oil level.

In other approaches, a plurality of absolute sensors, e.g., a barometric pressure sensor (BP) **51**, a compressor inlet pressure sensor (CIP) **58**, and/or a pressure sensor **61** in the crankcase vent tube **74**, may be used in combination to monitor crankcase ventilation system integrity. For example, in some approaches, a barometric sensor **51**, a compressor inlet sensor **58**, and a pressure sensor **61** in the PCV breather tube **74** may all be used in to monitor crankcase ventilation system integrity.

Turning to FIG. **2**, a method **200** for detecting crankcase breach and determining oil level using a single sensor in the engine of a vehicle is depicted. Method **200** may be carried out according to instructions stored in the memory of controller **48** in response to feedback from sensor **63**. Method **200** includes, at **202**, equalizing crankcase pressure to atmospheric pressure. Equalizing crankcase pressure to atmospheric pressure may include opening one or more valves coupling the crankcase to the atmosphere. For example, a pressure reference tube may be present between the crankcase and an air conduit of the engine open to the atmosphere. The reference tube may substantially surround the sensor in the crankcase. When a valve in the reference tube is opened, the sensor may be exposed to atmospheric pressure. Alternatively or additionally, the crankcase may be equalized with atmospheric pressure during engine off conditions. In other examples, the pressure sensor may be exposed to a reference pressure other than atmospheric pressure, such as vacuum or multiple specific pressures.

When the crankcase is equalized with atmospheric pressure and/or when the sensor is exposed to atmospheric pressure, the oil level in the oil well may be determined from sensor output at **204**. When the pressure of the gas (e.g., crankcase pressure) is at atmospheric pressure, the sensor senses only the pressure of the oil in which it is submerged. If the crankcase sensor is a pressure sensor, the sensor may output pressure in terms of voltage, which the controller may convert to oil depth (for example, mm of oil) based on the area of the oil well and the density of the engine oil. If the crankcase sensor is a level sensor that utilizes a float, for example, the sensor may mechanically or magnetically determine the depth of the oil in the oil well. The determined oil level may be stored in the memory of the controller to be used as a

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reference pressure or liquid level during a crankcase breach test, which will be described in more detail below.

At **206**, it is determined if the oil level is above a threshold. The threshold may be a predetermined threshold below which engine damage may occur due to lack of oil. If the oil level is not above the threshold, method **200** proceeds to **208** to take default action. Taking default action may include notifying an operator of the vehicle by activating a malfunction indicator light. Additionally, the default action may include adjusting one or more engine operating parameters to reduce depletion of lubricant from the oil well, such as limiting engine speed. In some embodiments, after taking default action in response to the oil level being below the threshold, method **200** may end. However, in other embodiments, method **200** may proceed to **210** to carry out the breach detection test, in order to determine if crankcase breach is a potential cause for the oil level being below the threshold.

If the oil level is above the threshold at **206**, or if default action has been taken at **208**, method **200** proceeds to **210** to build and maintain pressure or vacuum in the crankcase. This may include isolating the crankcase from the atmosphere at **212**. Isolating the crankcase from the atmosphere may include closing one or more valves coupling the crankcase to the atmosphere, such as valve **82** in the crankcase vent tube **74** and valve **84** in the PCV conduit **76**. At **214**, building and maintaining pressure or vacuum may include applying pressure or vacuum to the crankcase. Depending on the configuration of the engine and crankcase system, applying pressure or vacuum may occur in different ways. For example, if valves **82** and **84** are closed, during standard engine operation pressure may build in the crankcase due to blow-by gases and/or increasing engine heat. The maximum crankcase pressure would be limited by taking note of the resulting crankcase pressurization and opening the isolation valves above a threshold (and similarly for vacuum). In another example, instead of closing off the valves coupling the crankcase to the atmosphere, a PCV valve (such as valve **84** or **78**) may be opened during idle in order to build vacuum in the crankcase. In a further example, a pressure or vacuum source may be switched to the crankcase, for example a vacuum pump in the engine may be coupled to the crankcase to create vacuum in the crankcase. The example mechanisms listed above for increasing pressure or vacuum in the crankcase are non-limiting examples, and virtually any mechanism to increase pressure or vacuum in the crankcase is within the scope of this disclosure.

Upon building and/or maintain pressure or vacuum, at **216**, the crankcase pressure is determined based on the output from the crankcase sensor. If the crankcase sensor is a pressure sensor, the crankcase pressure may include the total pressure output by the sensor minus the pressure output by the sensor at atmospheric pressure. If the crankcase sensor is a level sensor, the pressure may be determined by measuring the oil level upon applying the pressure or vacuum and determining the difference between this oil level and the oil level determined at atmospheric pressure. The crankcase pressure may be determined over a given duration. For example, the crankcase pressure may be determined every second for a ten second duration, in order to monitor the change in pressure over time. If the crankcase is breached due to a small leak, the crankcase may be able to initially build vacuum or pressure, but may slowly lose the built pressure or vacuum over time. Thus, the crankcase pressure may be monitored for a given duration during the breach detection.

At **218**, it is determined if the crankcase pressure meets a predetermined condition relative to a threshold. The condition relative to the threshold is dependent on how and to what

extent the pressure or vacuum was built in the crankcase. For example, if vacuum is applied to the crankcase, breach may be indicated if the crankcase pressure is greater than the applied pressure (e.g., the crankcase does not reach a level of expected vacuum). If positive pressure is applied to the crankcase, breach may be indicated if the crankcase pressure is less than the applied pressure. Further, the condition relative to a threshold may include a magnitude of a slope of a plotted line of determined pressure over time. For example, the crankcase pressure may eventually reach the same amount as the applied pressure, but it may respond more quickly or more slowly to the applied pressure than expected.

If the crankcase pressure does not meet the condition relative to the threshold, method **200** proceeds to **220** to indicate crankcase breach. Upon indicating crankcase breach, default action may be taken at **222**. Default action may include notifying an operator of the vehicle of the detected breach, setting a diagnostic code, and/or taking mitigating action based on the detected breach. Additional information regarding the default action will be presented below with respect to FIG. **4**. Upon indicating breach and taking default action, method **200** exits.

Returning to **218**, if the crankcase pressure does meet the condition relative to the threshold, that is, if the determined crankcase pressure responds to the applied vacuum or pressure as expected, method **200** proceeds to **224** to indicate no breach detected, and then method **200** exits.

In embodiments where the engine is configured without isolation valves and a pressure or vacuum naturally occur in the crankcase, the above procedure may be used, relying on naturally occurring pressure/vacuum rather than imposed pressure/vacuum.

FIG. **3** illustrates example pressure sensor outputs during a breach detection routine. Diagram **310** illustrates expected crankcase pressure on the y axis and time on the x axis. Diagrams **320** and **330** illustrate pressure sensor output on respective y axes and time on respective x axes. Diagram **320** illustrates pressure sensor output in an engine with a crankcase that is not breached, while diagram **330** illustrates pressure sensor output with a breached crankcase. Referring first to diagram **310**, crankcase pressure is at atmospheric pressure prior to time **T1**. This may include an engine off period, or another suitable set of conditions wherein the crankcase pressure is equalized to atmospheric pressure. At time **T1**, the crankcase breach detection routine is initiated and the expected crankcase pressure increases above atmospheric pressure for a given duration. At time **T2**, the pressure that was applied to the crankcase is released and the crankcase pressure returns to atmospheric pressure.

Diagram **320** illustrates the pressure sensor output corresponding to the expected change in crankcase pressure. Prior to time **T1**, when crankcase pressure is at atmospheric pressure, the pressure sensor output corresponds to the pressure from the oil in the oil well in which the pressure sensor is submerged. This oil pressure may be converted to oil depth. Following the increase in expected pressure after time **T1**, the pressure output by the sensor increases corresponding to the increase in expected crankcase pressure. Thus, crankcase breach is not indicated. The crankcase pressure may be determined by the difference between the total sensed pressure after time **T1** (the oil and crankcase pressure) and the oil pressure determined prior to time **T1**.

Diagram **330** illustrates the pressure sensor output with a breached crankcase. Similar to diagram **320** above, oil pressure may be determined when the crankcase pressure is at atmospheric pressure. Following time **T1**, the pressure output by the sensor increases, but the pressure is not maintained as

expected. Rather, the pressure slowly returns to atmospheric pressure. Thus, crankcase breach is indicated.

FIG. **4** illustrates a method **400** for notifying an operator in response to detected crankcase breach. Method **400** may be carried out by controller **48** in response to indicated crankcase breach. For example, method **400** may be carried out during the execution of method **200** described above with respect to FIG. **2**.

At **402**, method **400** includes determining if a threshold number of breach detections have been reached. The breach detection routine, such as method **200** of FIG. **2**, may be rerun multiple times during a given engine operation duration. For example, the routine may be rerun continuously from key-on until key-off. When the routine indicates a crankcase breach, the controller may store each instance of breach detection for that engine operation duration, and execute a notification routine once a threshold number of detections have been reached. The threshold may be one breach detection in some embodiments. In other embodiments, to avoid false positive tests, the threshold may be multiple breach detections, such as two, five, ten, etc. If the threshold number of breach detections has not been reached, method **400** returns.

If the threshold number of breach detections has been reached, method **400** proceeds to **404** to display a message to a vehicle operator, such as activate a malfunction indicator light (MIL), to notify the operator of the vehicle of the detected crankcase breach. This may include, at **406**, prompting the operator to check for possible breach locations. The breach may be caused by a loose or missing oil cap, for example, or by a misaligned/loose dipstick, which the operator of the vehicle may be able to adjust in order to fix the breach. The prompt may be included in the activation of the MIL, or be a separate prompt. Method **400** also includes, at **408**, setting a diagnostic code.

At **410**, one or more operating parameters may be adjusted in response to the detected breach. The detected breach may prompt the controller to take mitigating action to prevent additional engine damage during engine operation with the breached crankcase.

A mitigating action is initiated by the electronic control unit of the motor vehicle. The mitigating action may include acting to delay a depletion of lubricant from the crankcase if the crankcase is indicated breached. In particular, the mitigating action may include reducing an intake of air into the engine, limiting a speed or torque of the engine, limiting a fuel injection amount supplied to the engine, limiting a throttle opening, disabling the turbocharger, and/or various other actions intended to limit an aspiration of engine lubricant from breached crankcase. In some embodiments, the mitigating action taken may be one of a plurality of mitigating actions taken when a crankcase breach is detected. In one example, the plurality of mitigating actions may include adding lubricant to the crankcase—pumping lubricant from an auxiliary reservoir and into the crankcase, for example. Upon adjusting the one or more engine operating parameters, method **400** exits.

It will be appreciated that the configurations and methods disclosed herein are exemplary in nature, and that these specific embodiments are not to be considered in a limiting sense, because numerous variations are possible. For example, the above technology can be applied to V-6, I-4, I-6, V-12, opposed 4, and other engine types. The subject matter of the present disclosure includes all novel and non-obvious combinations and sub-combinations of the various systems and configurations, and other features, functions, and/or properties disclosed herein.

The following claims particularly point out certain combinations and sub-combinations regarded as novel and non-obvious. These claims may refer to “an” element or “a first” element or the equivalent thereof. Such claims should be understood to include incorporation of one or more such elements, neither requiring nor excluding two or more such elements. Other combinations and sub-combinations of the disclosed features, functions, elements, and/or properties may be claimed through amendment of the present claims or through presentation of new claims in this or a related application. Such claims, whether broader, narrower, equal, or different in scope to the original claims, also are regarded as included within the subject matter of the present disclosure.

The invention claimed is:

1. An engine method, comprising:
indicating, via an electronic controller, both degradation of a crankcase ventilation system and a crankcase oil sump level based on a single common crankcase sensor, the crankcase oil sump level determined by the electronic controller in response to crankcase pressure being equalized with atmospheric pressure, where the single common crankcase sensor is a pressure sensor sensing pressure below an oil level of the crankcase oil sump.
2. The engine method of claim 1, wherein the indicating includes setting a diagnostic code and displaying a message to a vehicle operator.
3. The engine method of claim 1, wherein indicating both the degradation of the crankcase ventilation system and the crankcase oil sump level based on pressure sensor output further comprises:
determining the crankcase oil sump level in response to one or more valves coupling the crankcase to atmosphere being in an open position such that crankcase pressure is equalized with atmospheric pressure;
determining crankcase pressure based on the crankcase oil sump level and the pressure sensor output when crankcase pressure is not equalized with atmospheric pressure; and
adjusting engine operation in response to an indication of crankcase ventilation system degradation.
4. The engine method of claim 3, further comprising sealing the crankcase ventilation system and applying pressure to the crankcase ventilation system to set the crankcase pressure different than atmospheric pressure, where the indication is based on an output from the single common crankcase sensor at least while the crankcase pressure is set different than atmospheric pressure.

5. The engine method of claim 4, wherein degradation of the crankcase ventilation system is indicated if the determined crankcase pressure does not meet a predetermined condition relative to a threshold.

6. The engine method of claim 5, wherein the pressure applied to the crankcase ventilation system is greater than atmospheric pressure, and wherein the predetermined condition relative to the threshold comprises crankcase pressure greater than atmospheric pressure.

7. The engine method of claim 5, wherein the pressure applied to the crankcase ventilation system is less than atmospheric pressure, and wherein the predetermined condition relative to the threshold comprises crankcase pressure less than atmospheric pressure.

8. An engine system comprising:

a crankcase ventilation system including an oil well;

a pressure sensor positioned in the oil well and immersed in oil; and

a controller including instructions to:

during a first condition, determine oil well level based on output from the pressure sensor; and

during a second condition, indicate a breach in the crankcase ventilation system based on output from the pressure sensor.

9. The engine system of claim 8, wherein the controller includes instructions to indicate the breach in the crankcase ventilation system by determining a difference between the output from the pressure sensor during the second condition and the output from the pressure sensor during the first condition.

10. The engine system of claim 8, wherein the first condition comprises engine off operation and wherein the second condition comprises engine on operation and one or more valves coupling the crankcase to atmosphere being in a closed position.

11. The engine system of claim 8, wherein the controller includes instructions to convert the output from the pressure sensor to the oil well level based on density of the oil and area of the oil well.

12. The engine system of claim 8, wherein the breach is indicated if crankcase ventilation system pressure determined by the pressure sensor output is not maintained at an applied pressure.

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